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COURSE OF LECTURES

ON

NATURAL PHILOSOPHY,

&c.

VOLUME II.——PLATES.

A

COURSE OF LECTURES

ON

NATURAL PHILOSOPHY

AND THE

MECHANICAL ARTS.

53000

BY THOMAS YOUNG, M.D.,

FOR. SEC. R.S., FOREIGN ASSOCIATE OF THE ROYAL INSTITUTE OF FRANCE, MEMBER OF EMMANUEL COLLEGE, CAMBRIDGE, AND PROFESSOR OF NATURAL PHILOSOPHY IN THE ROYAL INSTITUTION OF GREAT BRITAIN.

A NEW EDITION, WITH REFERENCES AND NOTES,

BY THE

REV. P. KELLAND, M.A., F.R.S., LOND. & EDINB.,

LATE FELLOW OF QUEEN'S COLLEGE, CAMBRIDGE; PROFESSOR OF MATHEMATICS, ETC. IN THE UNIVERSITY OF EDINBURGH.

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DESCRIPTION OF PLATES.

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PLATE XI.

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PLATE XII.

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PLATE XIII.

Fig. 166. Joints for a tie beam. The joints at A and B cannot be more than half as strong as the entire beam, supposing the adhesion, produced by the pressure of the bolts, as strong as could be required. The joint at C is called a dovetail joint; its strength is a little less than that of A and B, but the adhesion is more easily secured, since a force tending to separate the beams must tighten the joint. P. 128.

Fig. 167. Joints for a tie beam. The joint A, if sufficiently tight, may possess of the strength of the beam. The joint B may be as strong as the beam, if the adhesion were great enough, but it would be difficult to apply sufficient pressure to create such an adhesion, and if the beam were subject to be much shaken, the joint would be a very bad one. P. 128.

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PLATE XIV.

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PLATE XV.

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PLATE XVI.

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Fig. 205. The duplex scapement. A B is the pallet, through which the cylinder, and the tooth which rests on it, are supposed to be seen, the point of the tooth being about to escape from the notch towards C. The short tooth D next impels the point of the pallet, and the long tooth E falls on the cylinder. It first rests on the convex surface, and then drops into the notch, which causes a slight recoil in the wheel, and passes by, the tooth F being beyond the reach of the pallet; but on its return, the tooth falls again into the notch; and when it escapes, the pallet is impelled as before. P. 150.

Fig. 206. Mr. Mudge's watch scapement. A, the scape wheel, and one of the subsidiary springs, seen from above; B, a general view of the balance, with both the subsidiary springs, seen from one side. The point of one of the teeth rests at C on the end of the pallet, which is bent so as to detain it until the pin D, which is attached to the balance, sets it a liberty, by striking against the arm E; this arm is then carried on by the balance, to the end of its vibration, and impels it in its return, until the pallet meets the next tooth. The other spring acts alternately in the same manner, but in a contrary direction. P. 151.

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Fig. 208. Mr. Arnold's watch scapement. The pin A, projecting from the verge or axis of the balance, moving towards B, carries before it the spring B, and with it the stiffer spring C, so as to set at liberty the tooth D, which rests on a pallet projecting from the spring. The angle E of the principal pallet has then just passed the tooth F, and is impelled by it until the tooth G arrives at the detent. In the return of the balance, the pin A passes easily by the detent, by forcing back the spring B. The screw H serves to adjust the position of the detent, which presses against it. P. 151.

Fig. 209. Mr. Earnshaw's scapement. A is the unlocking pallet, B the spring on which it acts, C the detent, holding the tooth D by a pin; E is the point of the principal pallet first impelled by the tooth F, G is the tooth next locked, and H the adjusting screw. P. 151.

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PLATE XVII.

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Fig. 219. A lewis, for raising stones. P. 161.

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Fig. 221. When the centre of gravity A is above the line joining the points of support B, C, the load is divided in the ratio of the segments C D, B D, terminated by the vertical line A D; but it may be supported by two equal forces in the directions B E, C F, found by making G H equal to B G, and joining C H; the angle G B E being equal to G H F; the forces and the weight may then be represented by the lines C I, I K, and C K. P. 162.

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PLATE XVIII.

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Fig. 227. The wheel A B, moving on a soft road towards B, has to overcome the resistance of the earth at C. P. 165.

Fig. 228. A section of the wheel of a carriage, a little dished, or inclined outwards. P. 166.

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Fig. 231. A sugar mill. The axis A is turned either by animal force or by water: the liquor is collected in the trough B, and runs off in the channel C. The openings D are for the purpose of adjusting the axes of the rollers. The canes are supplied by the hands of the workmen. P. 170.

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Fig. 236. A simple plough. A is the coulter, for dividing the ground; B the share, fixed on the mould board C, for turning it to the right hand; D is the rest, and E, F, the handles. P. 175.

Fig. 237. Section of a threshing mill. The corn is drawn in by the rollers or feeders A, B: it is beaten by the revolving beaters C, D, and the straw is drawn out by the rakes E, F, which discharge it at G; the grain falling through the arched bottoms H I, I G, which are formed like sieves. P. 178.

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PLATE XIX.

Fig. 239. The surfaces of the fluid in the bent tube A B remain on the same level, in the same manner as if the tube were absent, and the fluid made a part of that which is contained in the reservoir C D. P. 197.

Fig. 240. The bucket A being suspended by the rope B, and made to revolve rapidly round its axis, the surface of the water assumes a parabolic form. P. 198.

Fig. 241. A heavier fluid being contained in the upper part of the bent tube A B, which is immersed in the lighter fluid, filling the vessel C D, the fluid in the tube remains in a state of tottering equilibrium, when its surfaces are in the same level. P. 198.

Fig. 242. The fluid A B C presses on the bottom of the vessel B C with the same force as if the vessel were of the form B C D E. P. 199.

Fig. 243. The portion A B C D of the fluid being supposed to be congealed, and then to form a part of the vessel, the pressure on the bottom would remain unaltered. P. 199.

Fig. 244. The weight A may be supported by the pressure of a small quantity of fluid, either by making the surface of the vessel B C very large, and the height of the tube D E moderate, or, while the vessel F remains of a moderate size, by making the height of the tube G H very great. P. 199.

Fig. 245. The pressure on any small part of the side of the vessel A B, at C or D may be represented by the line C E, D F, and the whole pressure on the side by the triangle B G, of which the centre of gravity is at H; and if the side A I be supported by a single prop, it must be placed at the point K, the height of which is equal to that of H. P. 200.

Fig. 246. If the height of the surface A above B be to B C as the specific gravity of the fluid in B C to that of the fluid in A B, the fluids will support each other. P. 201.

Fig. 247. Two square beams floating at the depths shown at A and B, will have a certain degree of stability, but if they sink, as at C, they will overset. But a beam of the breadth shown at D will always float securely. P. 202.

Fig. 248. A jar containing images of fishes, with bubbles of air in them, which sink when the cover of the jar is pressed with the hand. P. 202.

Fig. 249. Dr. Hooke's semicylindrical counterpoise, by means of which a vessel is kept always full. P. 203.

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* Ph. Tr. 1665, p. 231.

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jet is supplied by the water of the cistern G, which is pumped up at H from a reservoir: it is drawn out, together with the air that is extricated from it by the air pump I, which throws it into the cistern K, whence the pump L raises it to the cistern M; and it enters the boiler through a valve, which opens whenever the float N descends below its proper place. The pipes O and P serve also to ascertain the quantity of water in the boiler. The piston rod is confined to a motion nearly rectilinear by the frame Q; the fly wheel R is turned by the sun and planet wheel S, T; and the strap U turns the centrifugal regulator W, which governs the supply of steam by the valve or stopcock X. P. 267.

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PLATE XXV.

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PLATE XXVI.

Fig. 357. The right half of the human larynx. A B C is the outline of the cricoid cartilage, D E F G H of the thyreoid, and I K L of the arytaenoid cartilage; M is the epiglottis, N K the upper ligament of the glottis, O P the lower ligament, and Q the trachea. P. 313.

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lines perpendicular to D E at any such distances, that B K may be to B L in a certain proportion, which is that of the sines of the angles of incidence A B M, C B M, to those of the angles of refraction F B N, G B N. B O and B P are the reflected portions of the rays. P. 322.

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PLATE XXVII.

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PLATE XXVIII.

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* Ph. Tr. 1777, lxvii. 789.

† Ibid. lxvii. 799; and Hell's Ephemerides, Anni 1789, Viennæ.

PLATE XXIX.

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PLATE XXX.

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PLATE XXXI.

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PLATE XXXII.

Fig. 471. A representing the sun, B the earth, and C the planet Mars; supposing Mars and the earth to set out together from D and E, the angle D A C was determined by Kepler from calculation, and the angles B A D and A B C by observation; whence it was easy to construct the triangle A B C, and to find the proportion of A B to A C. P. 402.

Fig. 472. The solar system, representing the form and proportions of the orbits of all the primary planets, and of three of the comets. The parts of the orbits represented by entire lines are on the north of the ecliptic, the dotted parts on the south: the letters A and P denote the aphelion and perihelion. The point in the centre, which ought to be only $\frac{1}{100}$ of an inch in diameter, represents the sun. The figures of the respective planets show their comparative magnitude, that of the sun being represented by the innermost of the graduated circles which inclose the whole: they are placed according to their actual situations on the 14th June, 1806. The letters M D show the mean distance of the comet of 1759, being placed at the extremity of the lesser axis of the ellipsis in which it must be supposed to revolve. P. 408.

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* Hist. et Mém. 1771, p. 458.

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Fig. 479. The appearance of Saturn, with his ring, from Dr. Herschel. P. 408.

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Names of the spots, according to Riccioli, and Hevelius.

1	Grimaldus or	Palus Mareotis	26	Hermes	Mons Bodinus
2	Galileus	Mons Audus	27	Dionysius	
3	Aristarchus	Mons Porphyrites	(*d*)	Albategnius	
4	Keplerus	Loca paludosa	29	Plinius	Promontorium Acherusia
5	Gassendus	Mons Cataractes			
6	Schikardus	Mons Troicus	30	S. Theophilus	Mons Moschi
7	Harpalus	Insula sinus hyperborei	31	Fracastorius	Lacus Thospitis
			32	Censorinus	Promontorium acutum
8	Heraclides	Caput mulieris			
(*b*)	Vulcanus		33	Messala	
9	Lansbergius	Insula Malta	34		Promontorium Somnii
10	Reinoldus	Mons Neptunus			
11	Copernicus	Mons Aetna	35	Proclus	Mons Corax
12	Helicon	Insula erroris	36	Cleomedes	Montes Riphaei
13	Capuanus	Regio Cassiotis	37	Snellius	Mons Paropamisus
14	Bullialdus	Insula Creta	38	Petavius	Petra Sogdiana
15	Eratosthenes	Insula Vulcania	39	Langrenus	Insula major
16	Timocharis	Insula Corsica	40	Taruntius	Sinus Phasianus
17	Plato	Locus niger major	A	Mare Humorum	
18	Archimedes		B	Mare Nubium	
(*a*)	Aratus		C	Mare Imbrium	
19	Insula sinus medii		D	Mare Nectaris	
20	Pitatus	Mare mortuum	E	Mare Tranquilitatis	
21	Tycho	Mons Sinai			
22	Eudoxus	Mons Carpathes	F	Mare Serenitatis	
23	Aristoteles	Mons Serrorum	G	Mare Foecunditatis	
24	Manilius	Insula Berbicus			
25	Menelaus	Byzantium	H	Mare Crisium	

Fig. 481..483. The satellites of Jupiter, Saturn, and the Georgian planet, at their proper distances, in proportion to the diameters of the planets, shown on the same scale. P. 408.

Fig. 484. The figure of the tail of the comet of 1680, represented in the plane of its orbit, from Newton. A B is the earth's orbit, C and D are the first and last appearances of the tail, and E F is the line of the nodes. P. 408.

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PLATE XXXIV.

Fig. 486. The gravitating body A B C, being supposed to revolve on the axis A C, the fluid column B D must be longer than E D, in order to support its pressure. P. 412.

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Fig. 488. A body attracted towards the centre A, and descending from B in the ellipsis B C D, has the inclination of its orbit to the revolving radius A B, A C, A D, perpetually changed, until at D it becomes perpendicular to it: but when the force increases more rapidly, the radius does not become perpendicular to the orbit till it arrives at E, and the line of the apsides A D moves forwards to E. P. 414.

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Fig. 491. The rays of light, coming in the direction A B, are bent by the atmosphere so as to arrive at C, and to illuminate a part of the atmosphere there, which is visible, by means of a second refraction, to a spectator at D, and occasions the first and last twilight. P. 527.

Fig. 492. Venus is at her greatest elongation or angular distance from the sun A, when situated as at B, with respect to the earth at C; and she is stationary at D, when she is moving with the same velocity as the earth, with respect to the direction of the earth's motion, the line E D being then more oblique, with respect to a fixed line, than either before or after. P. 418.

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Fig. 497. The path of the moon's shadow passing over the earth, in the solar eclipse of 1764, the earth being supposed at the same time to revolve on its axis. The line A B is the part in which the eclipse appeared annular, C D being the breadth of the whole shadow or penumbra. P. 420.

Fig. 498. The shadow of the moon falling on the earth. The true shadow not

extending here to the earth, the cone formed by the continuation of its outlines marks the extent of the parts in which the eclipse appears annular. P. 420.

Fig. 499. The termination of the moon's disc in a solar eclipse. From Dr. Herschel. P. 420.

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PLATE XXXV.

Fig. 502. A B being the earth's axis, the circle A C B is the meridian of the place C, and C D represents the plane of its horizon. P. 426.

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Fig. 504. A B being parallel to the earth's axis, the 12 planes passing through it, at equal angular distances, mark, on the circle C D perpendicular to it, the hour lines of an equatorial dial, and on the horizontal surface E F those of a horizontal dial. P. 427.

Fig. 505. A method of constructing a dial on any given plane. A B C is the elevation of the pole, or more generally, the angle which the surface makes with the gnomon A B. The circles are divided into equal parts, and 1, 2, 3, 4, 5, 6 are the hour lines, B being the place of the gnomon. The reason of this construction will appear by comparing the circle in the last figure with the ellipsis which is formed on the horizontal surface. P. 427.

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PLATE XXXVI.

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PLATE XXXIX.

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PLATE XLI.

Fig. 569. The form of the curves which show the direction of the magnetic needle, in consequence of the attraction and repulsion of two poles, situated at A and B. They are found by drawing the lines A C D, B E D, so that the sum or difference of the parts A C, B E, shall be always equal, A C E B being a semicircle; and the direction D F may be found by making A F to B F as the cube of A D to that of B D. P. 534.

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* Ph. Tr. 1757, p. 329. Account of Methods, 4to, 1758.
† Churchman's Magnetic Atlas, 1794.

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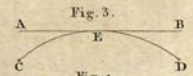
Fig. 2.

Fig. 3.



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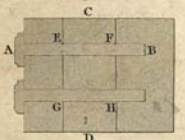

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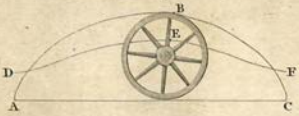

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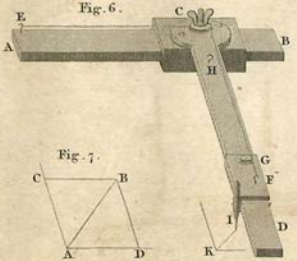

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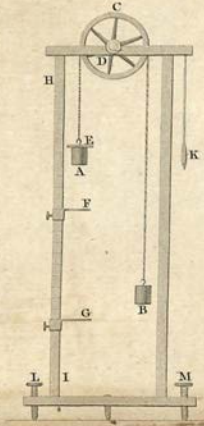

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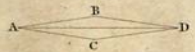

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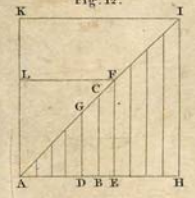

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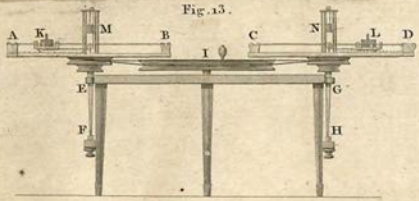

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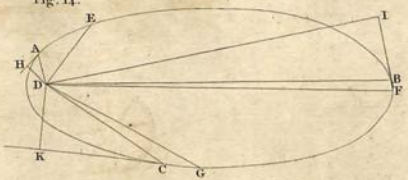


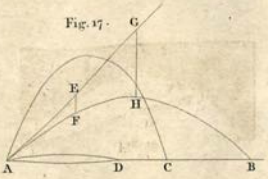
London Taylor & Walton, Upper Gower Street. 1846.

Jos.h Skelton. sculp.

Fig. 15.

Fig. 16.

Fig. 17.



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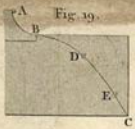

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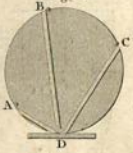

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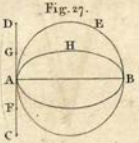

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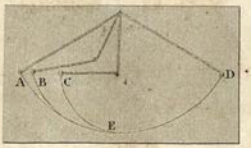

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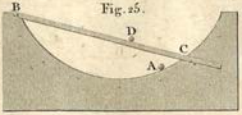

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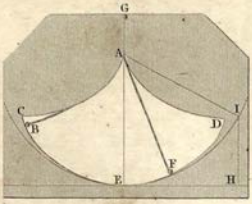

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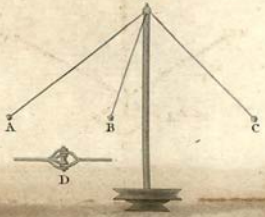

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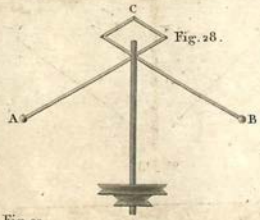

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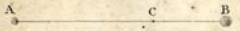

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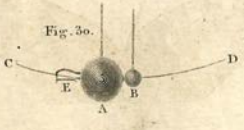
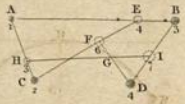


London, Taylor & Walton, Upper Gower Street. 1845

Joseph Shelton sculp.

Fig. 31.



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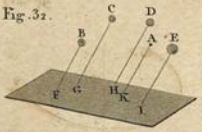

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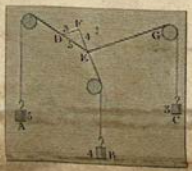

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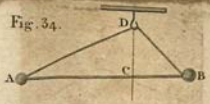

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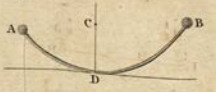

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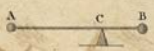
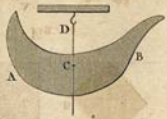


Fig. 38.



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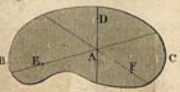
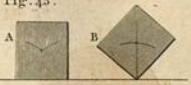


Fig. 40.

Fig. 41.

Fig. 42.

Fig. 43.



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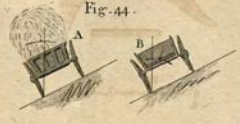


Fig. 45.

Fig. 46.

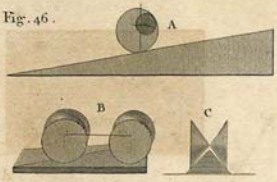
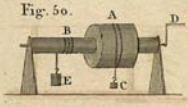


Fig. 47.

Fig. 48.

Fig. 49.

Fig. 50.



London: Taylor & Walton, Upper Gower Street, 1846.

Joseph Skelton, sculp.

Fig. 51.

Fig. 52.

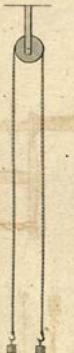


Fig. 53.

Fig. 54.

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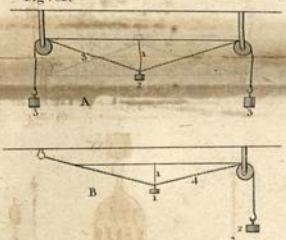
Fig. 61.



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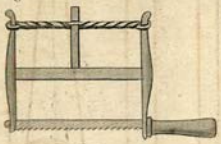

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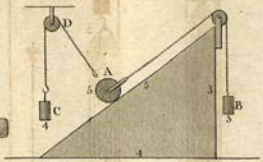

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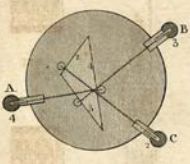


Joseph Skelton sculp.

Fig. 65.

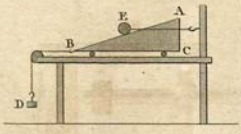


Fig. 66.

Fig. 67.

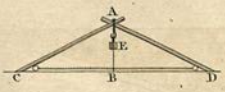
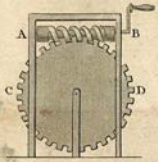


Fig. 69.

Fig. 68.

Fig. 70.



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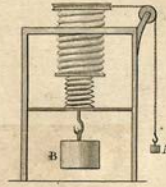
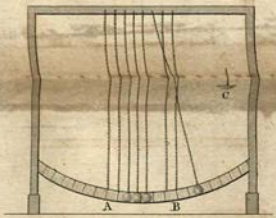


Fig. 75.

Fig. 72.



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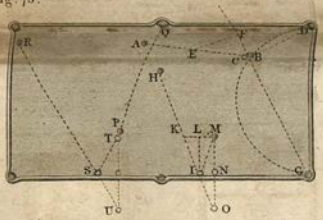

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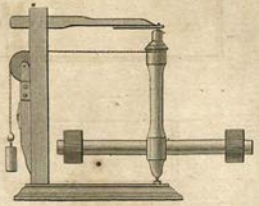

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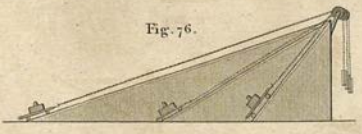


London. Taylor & Walton, Upper Gower Street. 1845.

Joseph Skelton sculp.

Fig. 77.

Fig. 78.

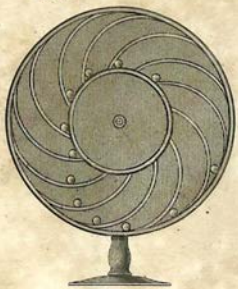
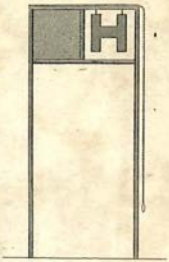


Fig. 79.

Fig. 80.



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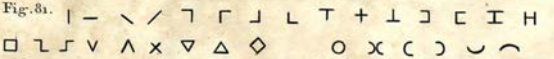

Fig. 82.

Fig. 83.

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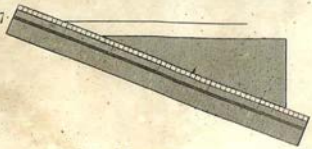
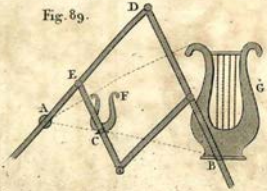


Fig. 88.

Fig. 89.



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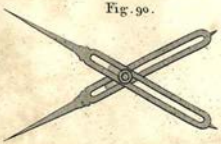


Joseph Skelton sculp.

London, Taylor & Walton, Upper Gower Street, 1845.

Fig. 91.

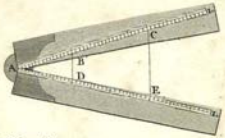
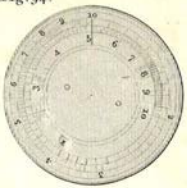


Fig. 92.

Fig. 94.



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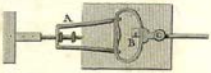
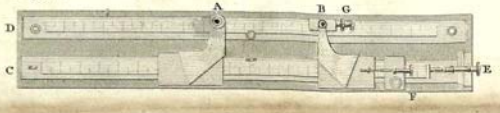


Fig. 95.

Fig. 96.



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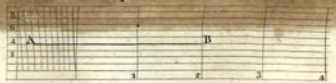
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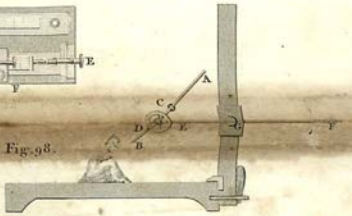

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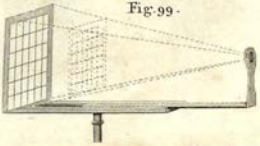

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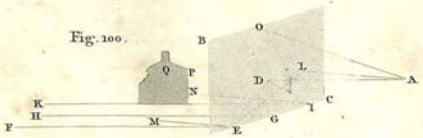

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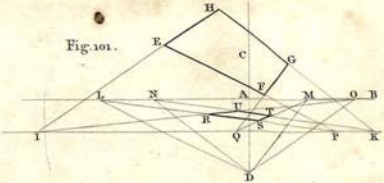

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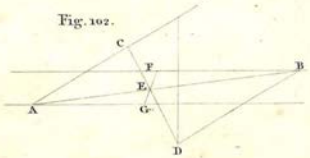
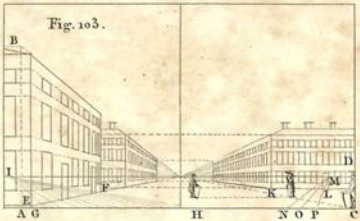


Joseph Bolton sculp.

London, Taylor & Walton, Upper Gower Street. 1845.

Fig. 103.



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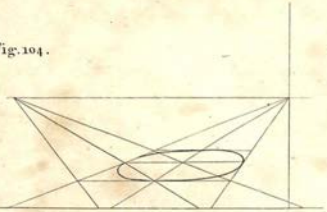

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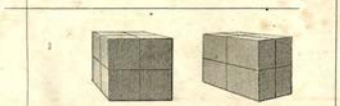

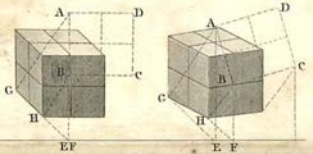

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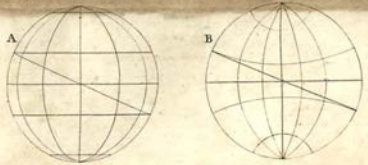

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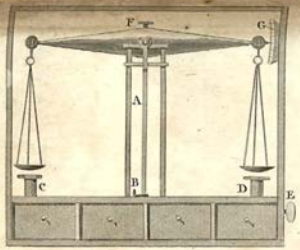

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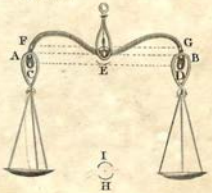


Fig. 109.

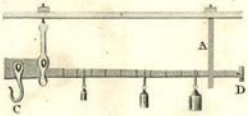
Fig. 110.

Joseph Skelton sculp.

London, Taylor & Walton, Upper Gower Street, 1845.

Fig.111.

Fig.112.



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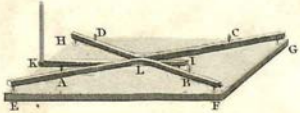


Fig.114.

Fig.115.

Fig.116.

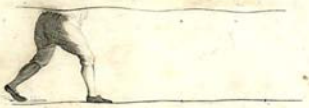


Fig.117.

Fig.118.

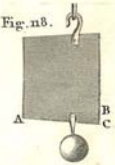
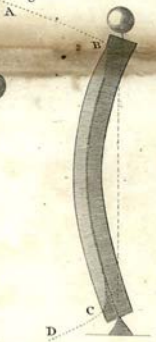


Fig.119.

Fig.120.



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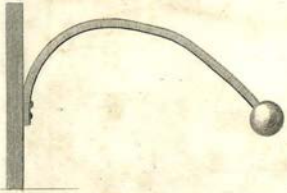


Fig.122.

Fig.123.

Joseph Skelton sculp.

London. Taylor & Walton, Upper Gower Street. 1843.

Fig.124.

Fig.125.

Fig.126.

Fig.127.

Fig.131.

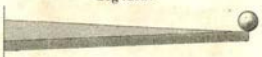


Fig.132.

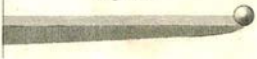


Fig.128.

Fig.129.

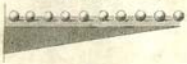
Fig.130.

Fig.133.

Fig.134.

Fig.135.

Fig.136.



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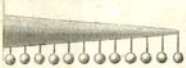


Fig.138.

Fig.139.

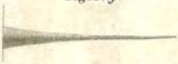


Fig.140.

Fig.141.

Fig.142.

Fig.143.

Fig.144.

Fig.145.

Fig.146.

Fig.147.

Fig.148.

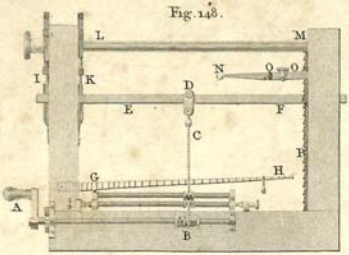


Fig.149.

Fig.150.

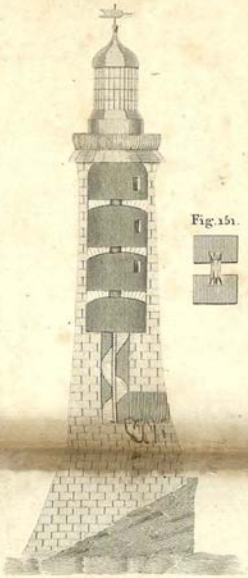
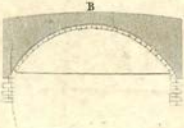


Fig.151.

Fig.152.

Fig.153.

Fig.154.



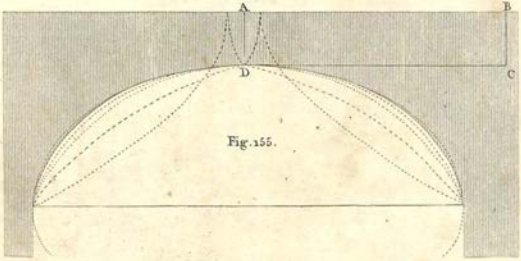


Fig.155.

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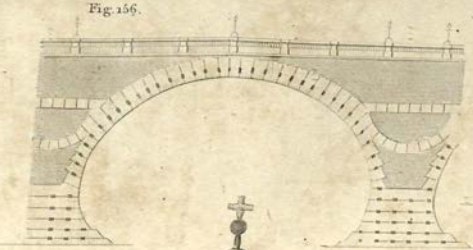
Joseph Skelton sculp.

Fig. 156.



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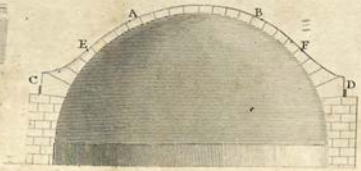


Fig. 158.

Fig. 159.

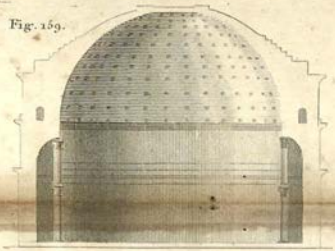


Fig. 160.

Fig. 161.

Fig. 162.

Fig. 163.

Fig. 164.

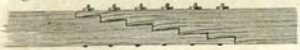
Fig. 165.

Joseph Skelton sculp.

Fig. 166.

Fig. 167.

Fig. 168.



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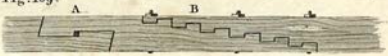

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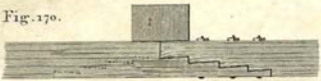

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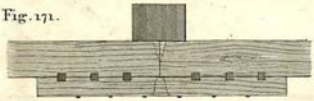
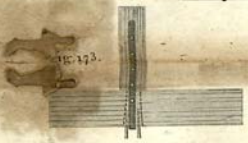


Fig. 172.

Fig. 173.

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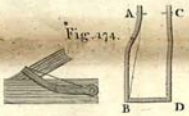

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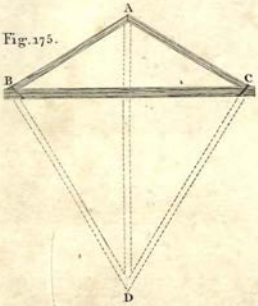

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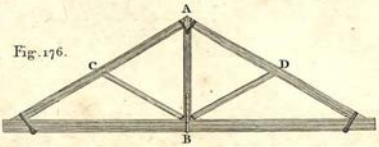

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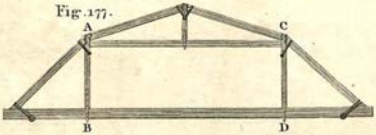

Joseph Skelton sculp

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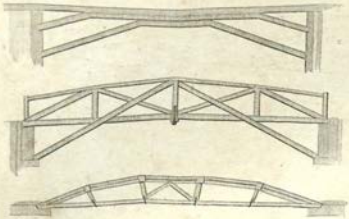
Fig. 178.



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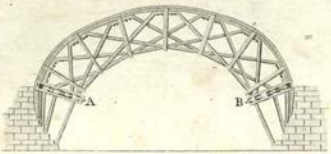


Fig. 180.

Fig. 181.

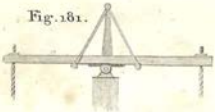
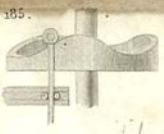


Fig. 182.

Fig. 183.

Fig. 184.

Fig. 185.



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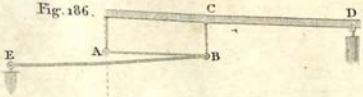

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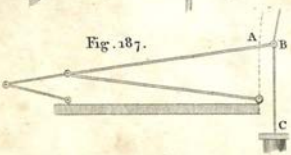

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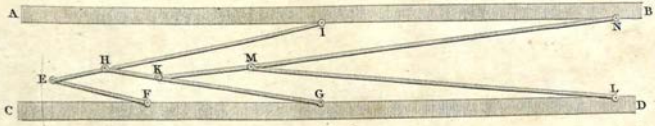

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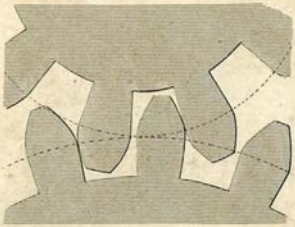
Fig. 189.

Fig. 190.



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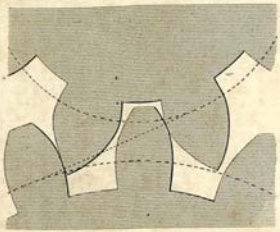

Fig. 192.

Fig. 193.

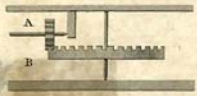

Fig. 194.

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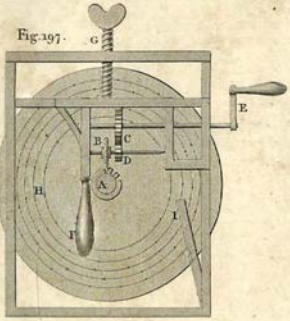
Fig. 197.



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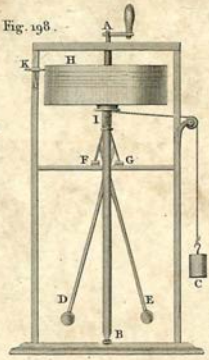

Fig. 199.

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Fig. 200.

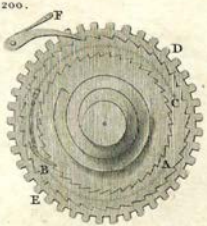

Fig. 201.

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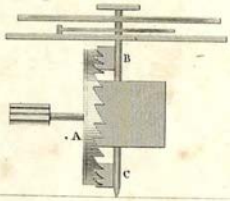

Fig. 203.

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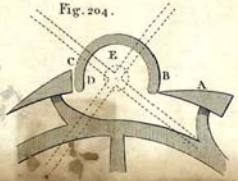

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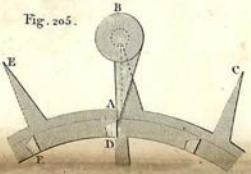

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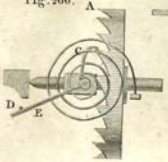

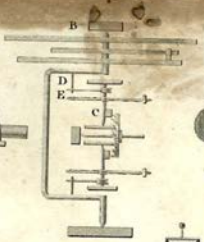

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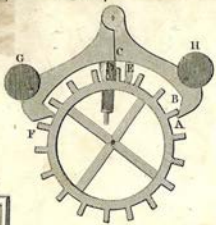

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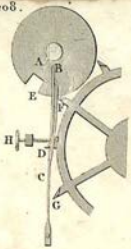

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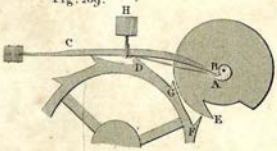
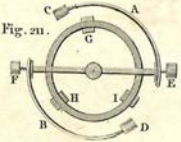


Fig. 210.

Fig. 211.



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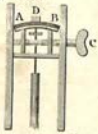

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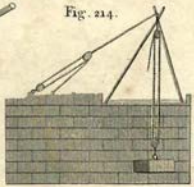
Joseph Skelton. sculp.

Fig. 213.

Fig. 214.



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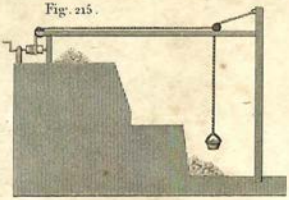

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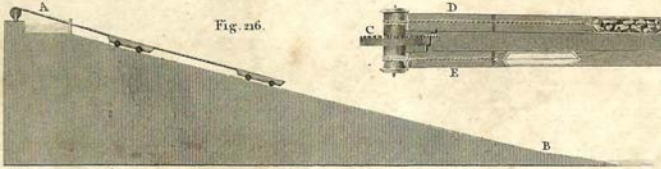

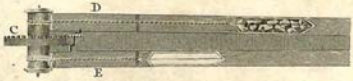

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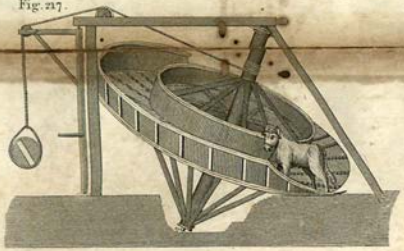

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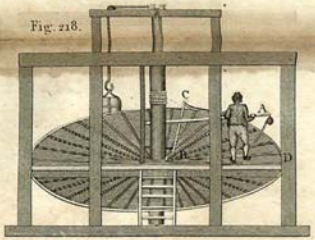


Fig. 219.

Fig. 220.

Fig. 221.

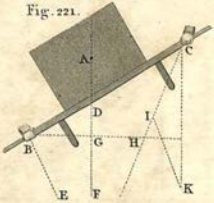
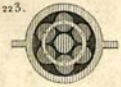


Fig. 222.

Fig. 223.



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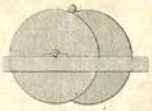
Joseph Skelton. sculp.

Fig. 224.



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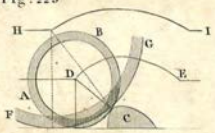

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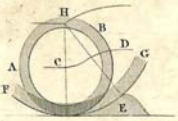
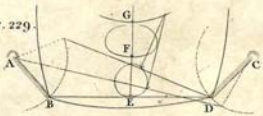


Fig. 227.

Fig. 228.

Fig. 229.



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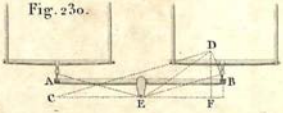
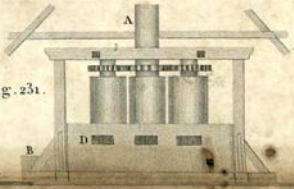


Fig. 231.



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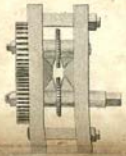

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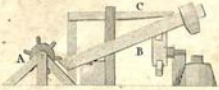

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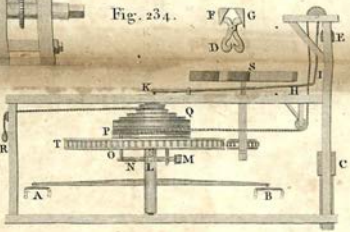
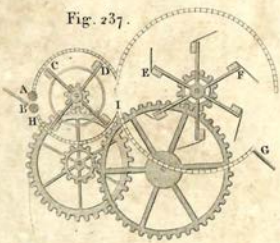


Fig. 235.

Fig. 236.

Fig. 237.



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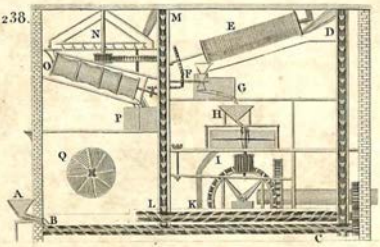


Joseph Shelton sculp.

London. Taylor & Walton, Upper Gower Street 1845.

Fig. 239.

Fig. 240.

Fig. 241.

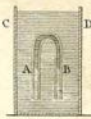
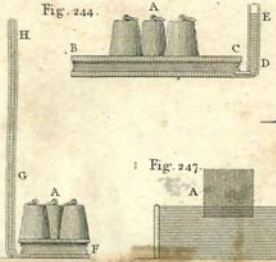


Fig. 242.

Fig. 243.

Fig. 244.



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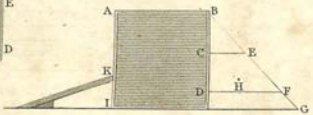


Fig. 246.

Fig. 247.

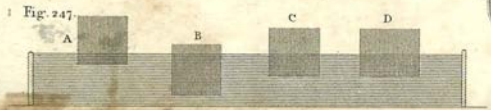


Fig. 248.

Fig. 249.

Fig. 250.

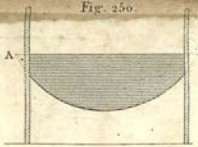
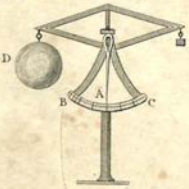


Fig. 251.

Fig. 252.



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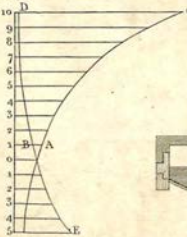

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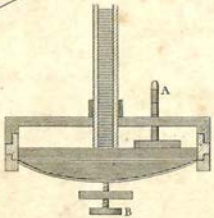
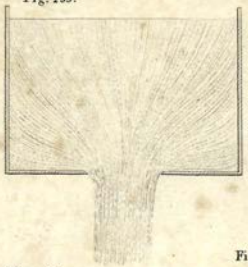


Joseph Skelton sculp

London, Taylor & Wilkins, Tilyard Gower Street 1841.

Fig. 255.



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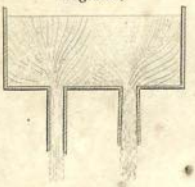

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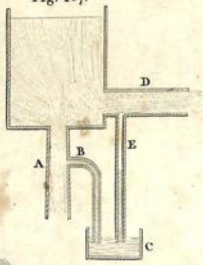


Fig. 258.

Fig. 259.

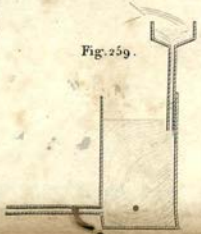
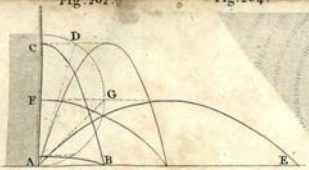


Fig. 260.

Fig. 263.

Fig. 262.



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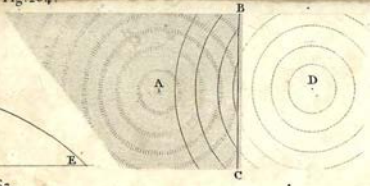

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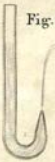
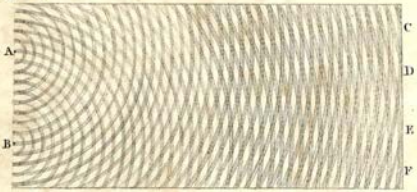


Fig. 266.

Fig. 267.



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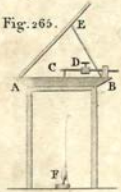
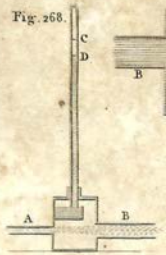


Joseph Skelton sculp.

London, Taylor & Walton, Upper Gower Street. 1835.

Fig. 268.



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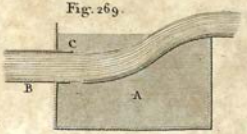
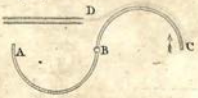


Fig. 270.

Fig. 271.



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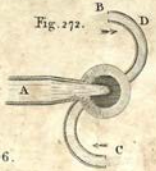

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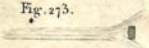

Fig. 274.

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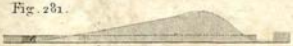

Fig. 282.

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Fig. 284.

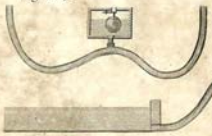
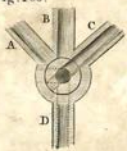


Fig. 285.

Fig. 286.



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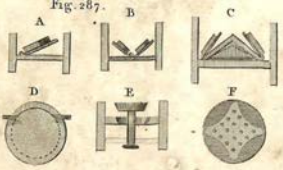
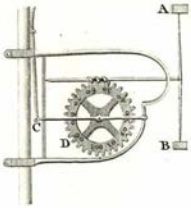


Joseph Skelton sculp.

Fig. 288.



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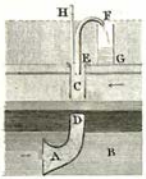

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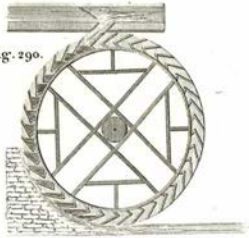

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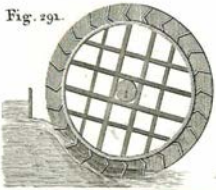

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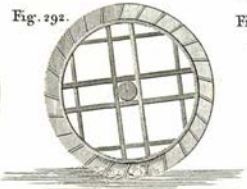

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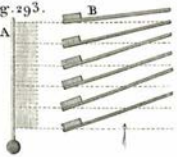

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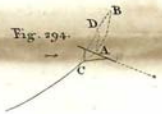

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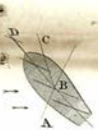

Fig. 296.

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Fig. 300.

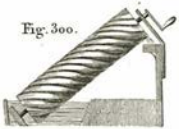


Fig. 301.

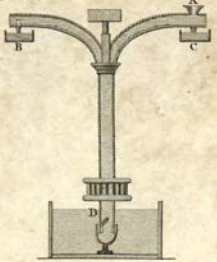
Fig. 302.

Fig. 303.

London: Taylor & Walton, Upper Gower Street. 1843.

Joseph S.

Fig. 304.



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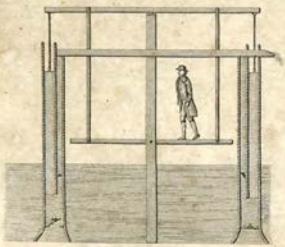

Fig. 306.

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Fig. 308.

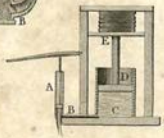


Fig. 309.

Fig. 310.

Fig. 311.

Fig. 312.

Fig. 313.

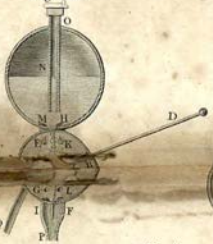
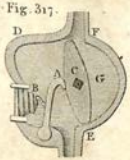


Fig. 314.

Fig. 315.

Fig. 316.

Fig. 317.



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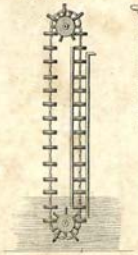

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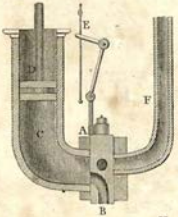

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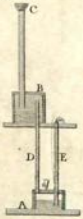

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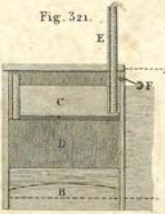

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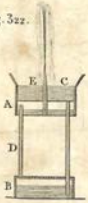
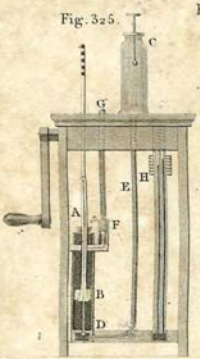


Fig. 323.

Joseph Skelton sculp.

Fig. 324.

Fig. 325.



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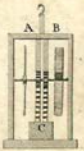

Fig. 327.

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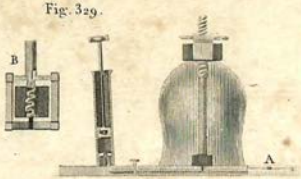

Fig. 330.

Fig. 331.

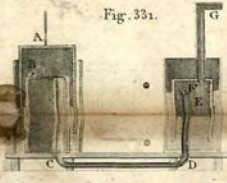

Fig. 332.

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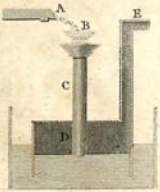

Fig. 334.

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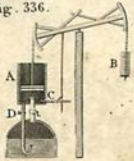

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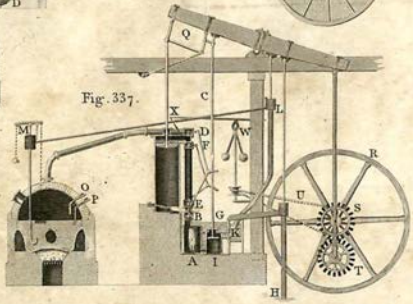

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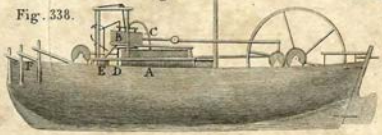

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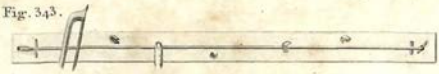
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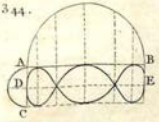

Fig. 345.

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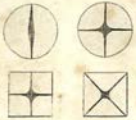

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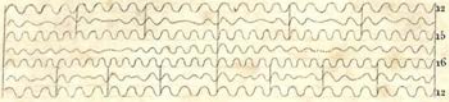


Fig. 354.

Fig. 355.

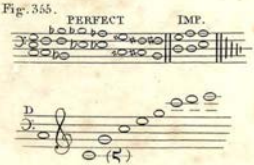



Fig. 356.

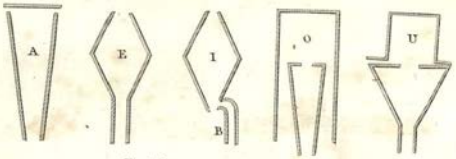
London: Taylor & Walton, Upper Gower Street, 1845.

Joseph Shelton sculp.

Fig. 357.

Fig. 358.

Fig. 359.



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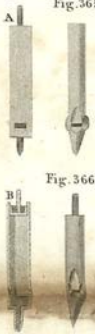

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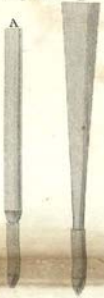

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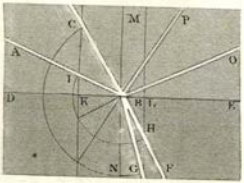

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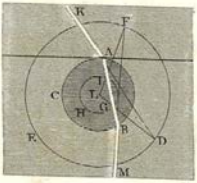

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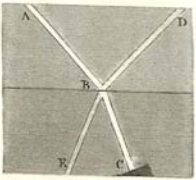

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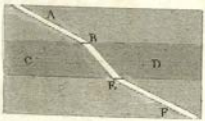

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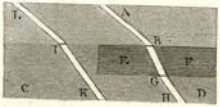


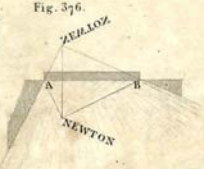
Fig. 374.

Joseph Skelton sculp.

London, Taylor & Walton, Upper Gower Street. 1841

Fig. 375.

Fig. 376.



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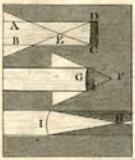

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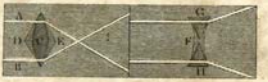

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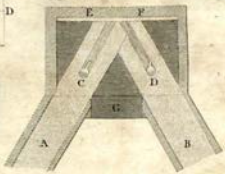

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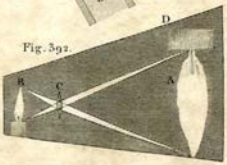

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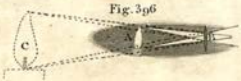
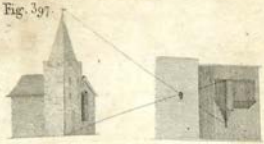


Joseph Stelter sculp.

Fig. 397.



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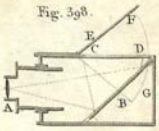

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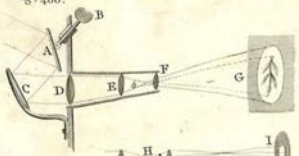

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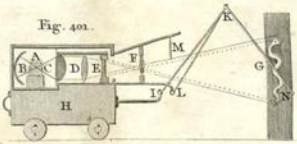

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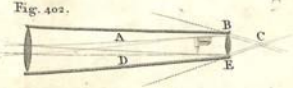

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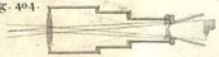

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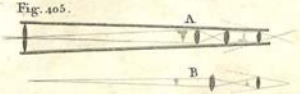

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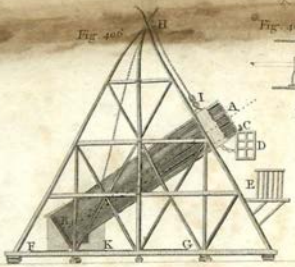

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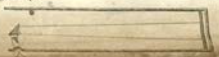

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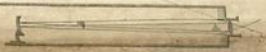

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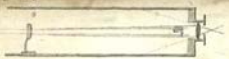

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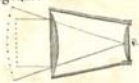

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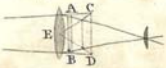

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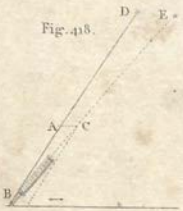

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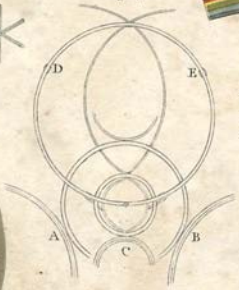

Fig. 434.

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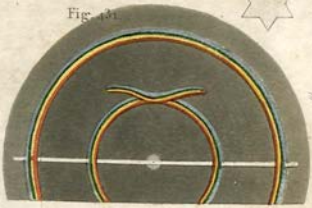

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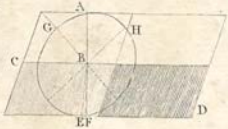
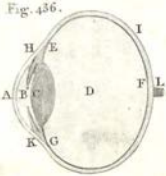


BAXTER'S PATENT OIL PRINTING,
9 NORTHAMPTON SQUARE.

Fig. 436.



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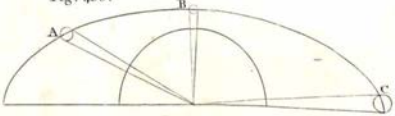

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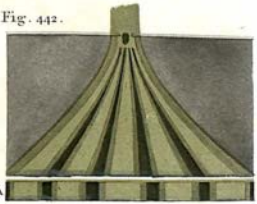

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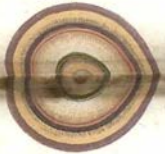

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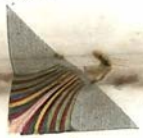

Fig. 447.

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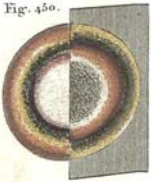

Fig. 451.

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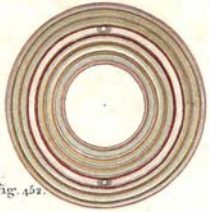

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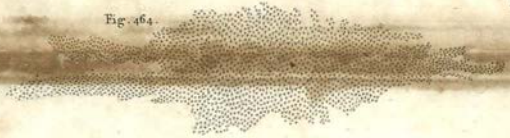

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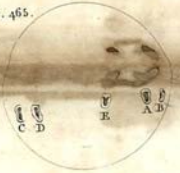

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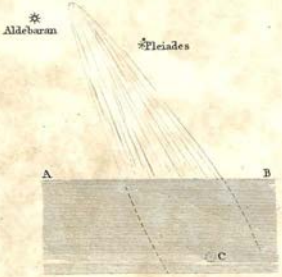
Fig. 469.

Fig. 470.



Joseph Skelton sculp

London: Taylor & Walton, Upper Gower Street, 1836.

Fig. 471.

Fig. 472.

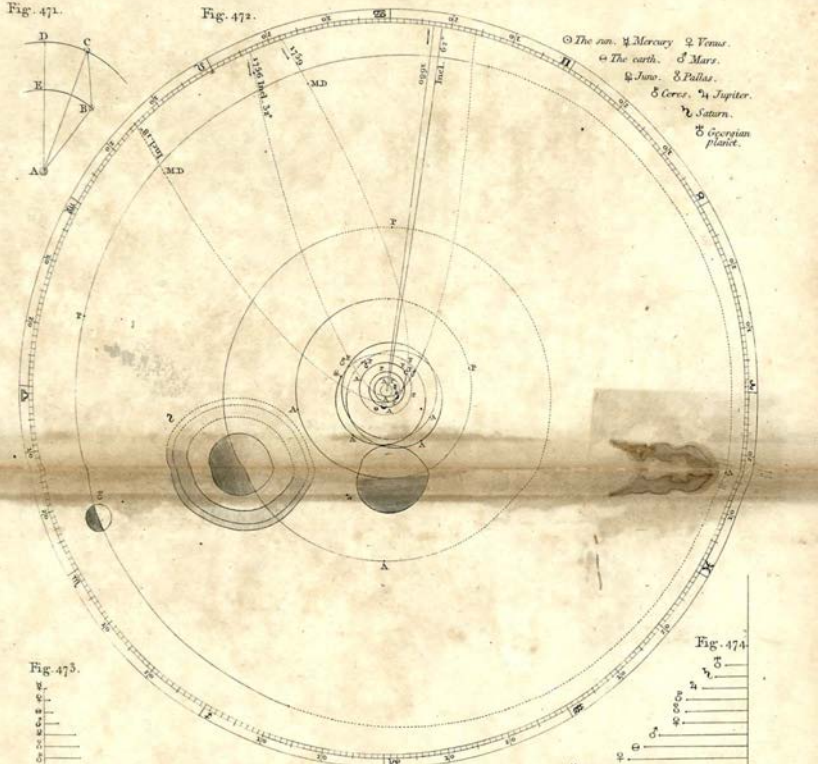


Fig. 473.

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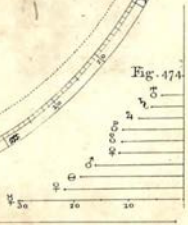


Fig. 475.

Joseph Skelton, sculp.

London, Taylor & Walton, Upper Gower Street, 1845.

Fig. 476.

Fig. 477.

Fig. 478.

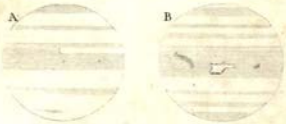
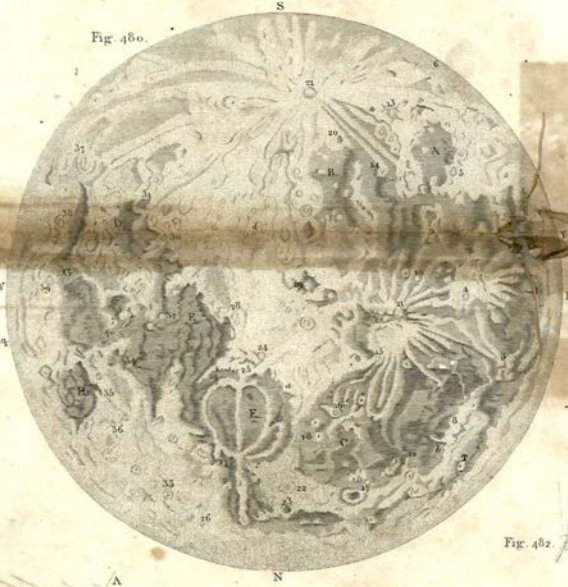


Fig. 479.

Fig. 480.



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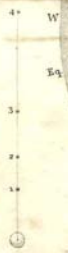

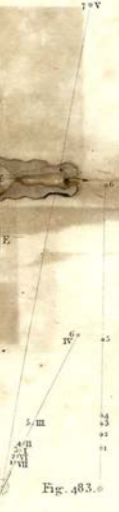

Fig. 482.

Fig. 483.

Fig. 484.

Fig. 485.

Joseph Skelton, sculp.

London, Taylor & Walton, Upper Gower Street, 1845.

Fig. 486.

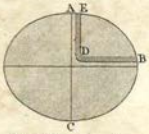

Fig. 487.

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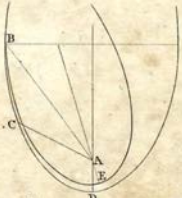

Fig. 489.

Fig. 490.

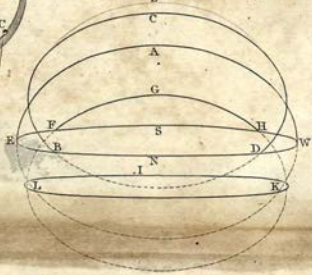

Fig. 491.

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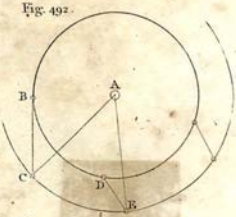

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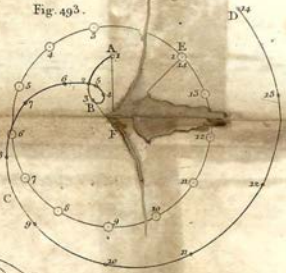
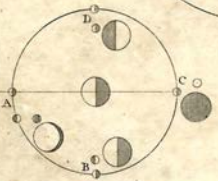


Fig. 494.

Fig. 495.

Fig. 496.

Fig. 497.



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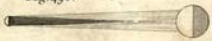
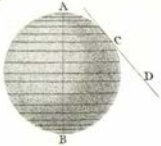


Fig. 499.

Fig. 500.

Fig. 501.

Fig. 502.



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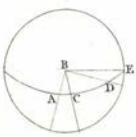

Fig. 504.

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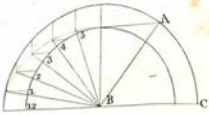
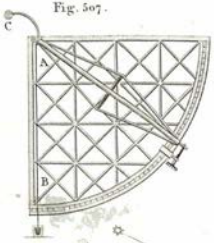


Fig. 506.

Fig. 507.



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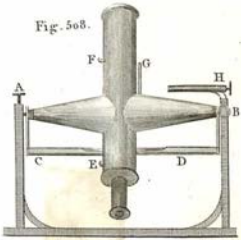

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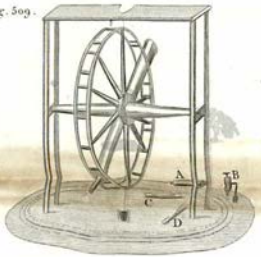

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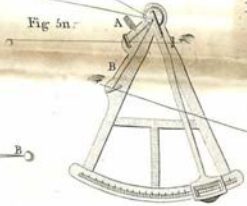

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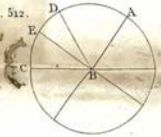
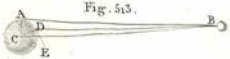


Fig. 510.

Fig. 513.



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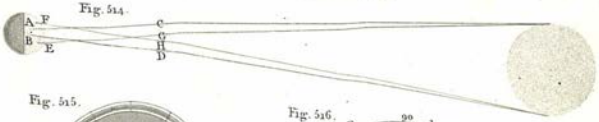

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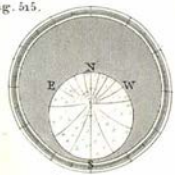

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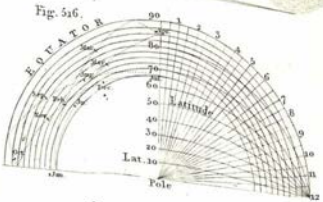
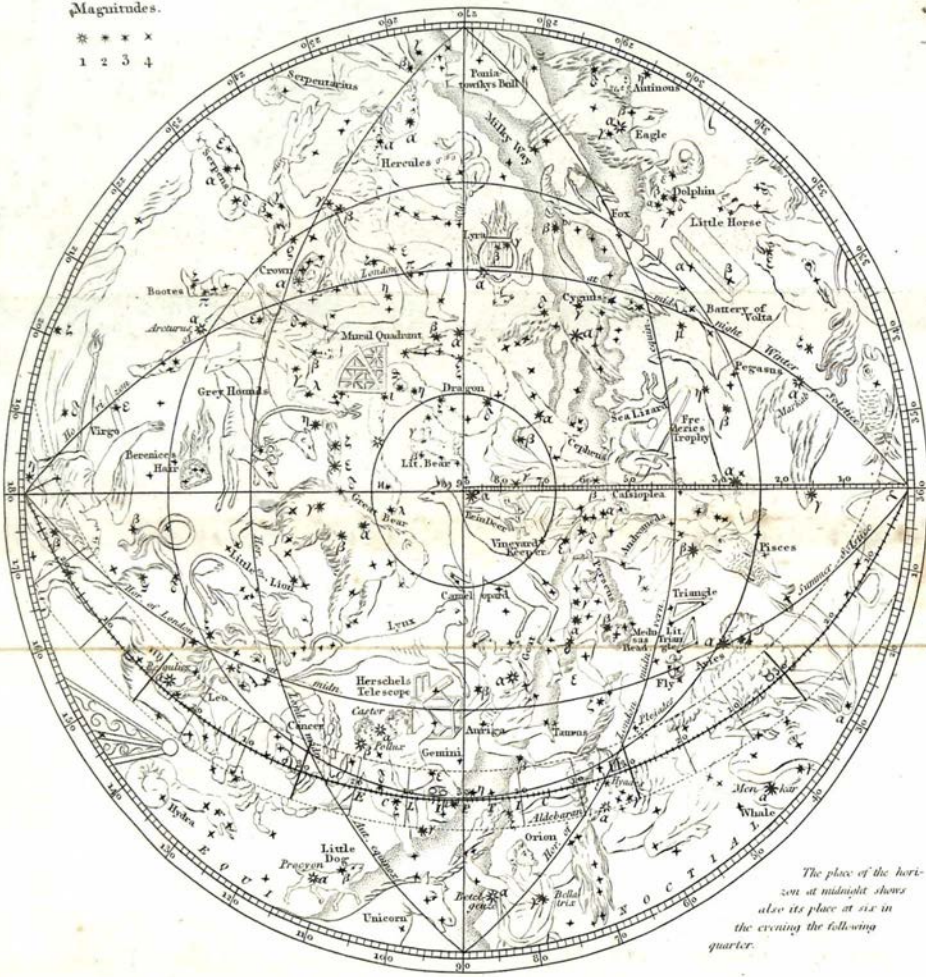


London. Taylor & Walton, Upper Gower Street. 1846.

PLATE XXXVI. Fig. 517.



The place of the horizon at midnight shows also its place at six in the evening the following quarter.

PLATE XXXVII. Fig. 518.

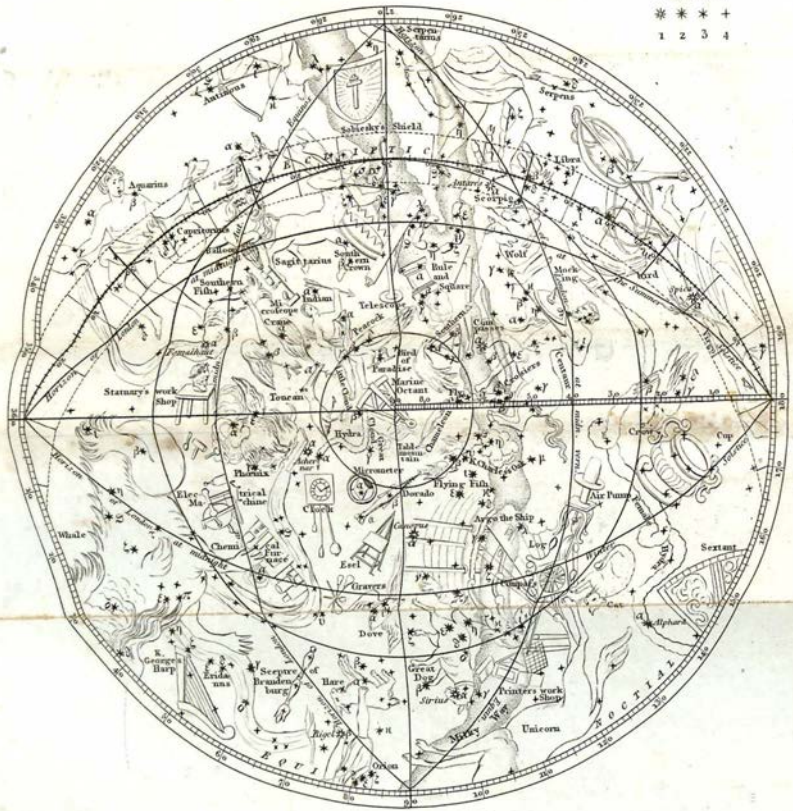
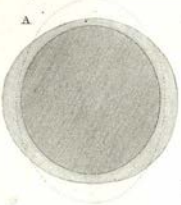


Fig. 519.

Fig. 520.



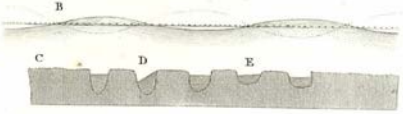


Fig. 521.

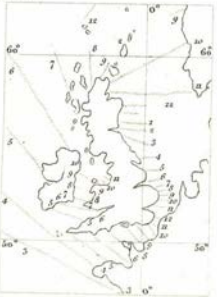


Fig. 522.

Fig. 523.

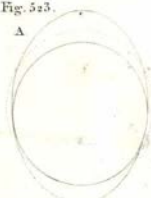


Fig. 524.

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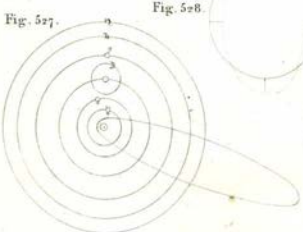
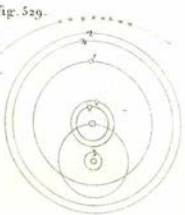


Fig. 528.

Fig. 529.



London. Taylor & Watson. Upper Gower Street. 1845.

Joseph Bolton sculp.

Fig. 530.

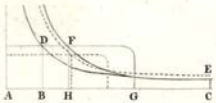
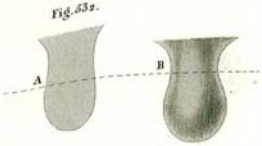


Fig. 531.

Fig. 532.



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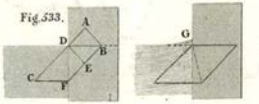
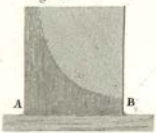


Fig. 534.

Fig. 535.



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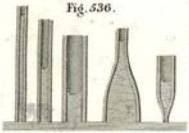

Fig. 537.

Fig. 538.

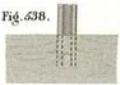

Fig. 539.

Fig. 540.

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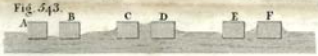
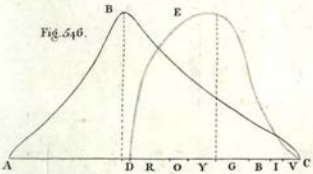


Fig. 544.

Fig. 545.

Fig. 546.



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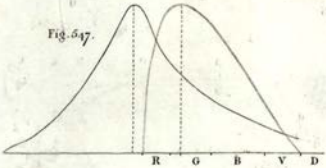

Fig. 548.

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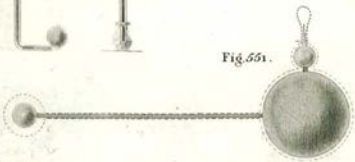
Fig. 551.



Jos. Skelton sculp.

London. Taylor & Walton. Upper Gower Street. 1845

Fig. 552.

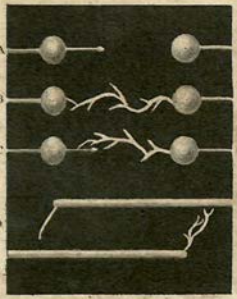


Fig. 553.

Fig. 554.

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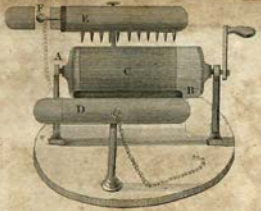
Fig. 560.

Fig. 558.



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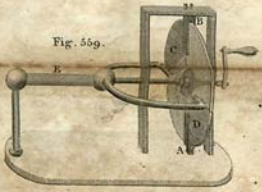


Fig. 561.

Fig. 562.

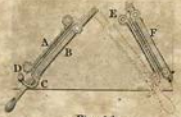


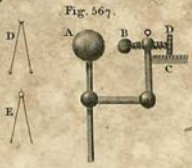
Fig. 563.

Fig. 564.

Fig. 565.

Fig. 566.

Fig. 567.



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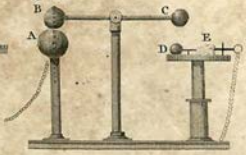
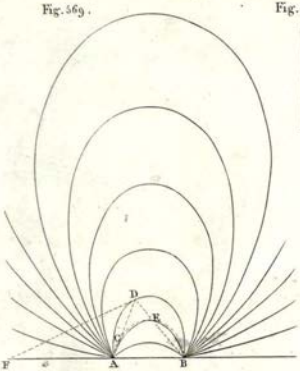


London. Taylor & Walton. Upper Gower Street. 1845.

Joseph. Skelton. sculp.

Fig. 569.



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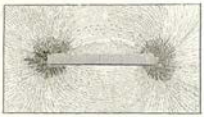

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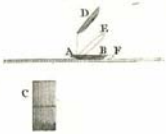


Fig. 572.

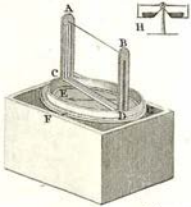


Fig. 573.

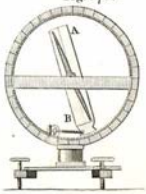


Fig. 574.

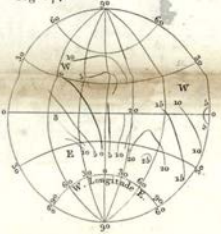


Fig. 575.

Fig. 576.

Fig. 577.

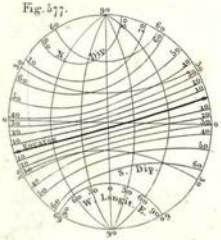


Fig. 578.

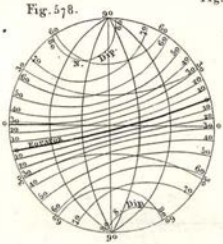


Fig. 579.

Fig. 580.

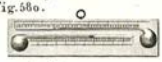
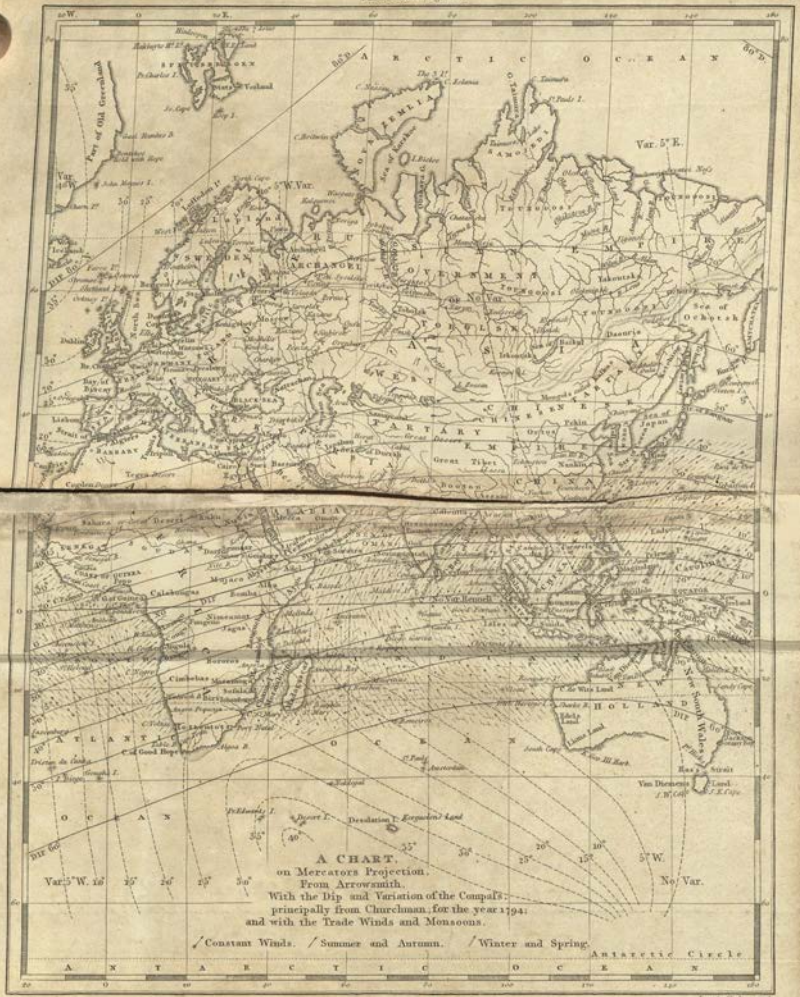


Fig. 581.

Joseph Skelton sculp.

London: Taylor & Walton, Upper Gower Street. 1845.

Var. 40° W.
No Var.
Var. 26° E.
Antarctic Circle
ANTARCTIC OCEAN
BAFFINS BAY
GREENLAND
NORTH AMERICA
SOUTH AMERICA
ATLANTIC OCEAN
PACIFIC OCEAN
Arctic Circle
Tropic of Capricorn
Equator
TCHUKTSKOI
KAMTSCHATKA
NEW HOLLAND
TIERRA DEL FUEGO
Terra del Fuego
Falkland Is.
Georgia
Sandwich Isles



A CHART,
on Mercators Projection.
From Arrowsmith.
With the Dip and Variation of the Compass
principally from Churchman, for the year 1794.
and with the Trade Winds and Monsoons.

/ Constant Winds. / Summer and Autumn. / Winter and Spring.

00053090

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